



MOKELUMNE WATERSHED AVOIDED COST ANALYSIS:

Why Sierra Fuel Treatments Make Economic Sense



Chapter 1: Introduction

1.1 Introduction and Context

Sierra Nevada watersheds provide a wide range of benefits for people and nature. Many of these benefits, like clean water and clean air, do not have an accepted market value and therefore are not readily considered in decisions regarding how watersheds are managed. By rigorously quantifying the “ecosystem services” provided by healthy watersheds, we can begin to incorporate these important values into land and water management decisions and investments.

The forests of the Sierra Nevada, like many forests throughout the western United States, are overly dense with small trees and brush and are at risk of uncharacteristic, high-severity wildfires. Megafires, like the 2013 Rim Fire that burned into Yosemite National Park, threaten lives and property as well as a host of values, including wildlife habitat, water quality, carbon storage, recreation, and timber. Fuel reduction activities, like mechanical thinning and controlled burning, can modify fire behavior, but the pace and scale of fuel treatments are insufficient given the magnitude of the problem.

Using the Mokelumne watershed as a test case, this study addresses the following question: Does it make economic sense for society to increase investment in fuel reduction in Sierra Nevada forests, taking into account the broad range of benefits that such activities provide?

The Mokelumne River is located on the western slope of the north-central Sierra Nevada. In addition to being a primary tributary for the Sacramento-San Joaquin River Delta, the Mokelumne River produces 215 MW of hydropower capacity, provides 1.3 million San Francisco East Bay residents with their drinking water, and supplies water for agricultural and municipal purposes. The primary utilities in the watershed that provide these services are the East Bay Municipal Utility District (EBMUD) and Pacific Gas & Electric (PG&E). The watershed also holds extensive forest stands under public and private ownership, including the U.S. Forest Service (USFS), Bureau of Land Management (BLM), and Sierra Pacific Industries. Like other Sierra watersheds, the Mokelumne watershed has experienced fires in the last few decades, including the 2004 Power Fire, and is at risk of even larger and more severe wildfires in the future.

This report details the process and results of a collaborative project that combined stakeholder input with scientific and economic analysis to quantify the risks and costs associated with wildfire in the upper Mokelumne River watershed. These costs, which recent fire seasons in the West have demonstrated can be in the tens to hundreds of millions of dollars per fire, are weighed against the potential benefits provided by strategically placed forest fuel treatments in high-fire-threat areas.

To investigate the value of investing in fuel treatments, a broad group of stakeholders came together, with leadership from the Sierra Nevada Conservancy, USFS, and The Nature Conservancy, to conduct research into the benefits and costs of a strategy to accelerate fuel treatments implementation in the watershed for the purpose of reducing wildfire risk and the risk of postfire erosion. This report details that effort and the variety of biophysical and economic

modeling and analyses used to answer the question: “what future costs can be avoided by treating the upper Mokelumne River watershed to reduce the risk of wildfire?”

This project involved many stages of analysis, all of which included review and input from a wide variety of public and private stakeholders, including public and private landowners, utilities and businesses, environmental organizations, local residents, and regulatory agencies. We undertook studies to simulate the locations and severity of future wildfire in the watershed with and without fuel treatments and to project how those modeled wildfires would affect local and regional assets both from direct fire damage and from postfire erosion and debris flows into downstream reservoirs and other watershed infrastructure. We considered the economic value of resources affected directly by wildfire and indirectly by the subsequent erosion and sediment effects. We attempted to identify not only what these potential costs might be, but also who the beneficiaries would be.

The chapters of this report describe the methods and results for the full series of analyses necessary to arrive at a rigorous and scientifically valid set of data describing the costs and benefits of fuel treatments in the upper Mokelumne. Subsequent chapters typically rely upon results from preceding chapters. The final results are presented in terms of economic values for these effects and the distribution of effects, while interim chapters provide details on the methodology and quantitative results of fire, erosion, and sediment modeling efforts. The appendices (A-J) provide additional details regarding the modeling efforts and other analyses processes.

1.2 Wildfire Risk and Effects

Wildfire can increase the subsequent severity of flooding and erosion in watersheds, as well as the introduction of nutrient and metal contaminants to waterways (Writer 2012). Throughout the West, observed postfire erosion levels have been observed to be multiple times, or even orders of magnitude, greater than prefire conditions (e.g., Badia 2008; Carroll 2007; Mayor 2007). Additionally, while the West has experienced more dramatic fire seasons, fuel-thinning treatments have demonstrated their value in reducing the extent of infrastructure damage around where they are implemented.

As science provides better understanding of the economic value of services functional watersheds provide, communities are better able to quantify the cost savings from investing in green infrastructure as opposed to traditional gray infrastructure such as water treatment plants. Watersheds provide valuable water supply and water quality treatment to communities across the country, and the value of these services is well documented. New York City famously saved billions of dollars through a \$1.5 billion investment in watershed protection, and many cities, including Boston, Seattle, and Portland, OR, are also avoiding hundreds of millions of dollars in water treatment costs through heightened watershed protection (Postel 2005). This premise also extends to preventative efforts, rather than after-the-fact repairs, reconstruction, and clean-up, as demonstrated with the Wallow Fire in Arizona.

Communities are recognizing the benefit of directly investing in efforts to reduce wildfire risk. Denver Water provides drinking water to 1.3 million people in the Denver metropolitan region

from a variety of surface water sources and is investing in actions aimed at reducing the wildfire risk that threatens those sources. One of these sources is Strontia Springs Reservoir, which received over a million cubic yards of sediment runoff from storms that followed the 11,900-acre Buffalo Creek Fire (1996) and the 138,000-acre Hayman Fire (2002) (Denver Water 2013). The runoff led to increased levels of manganese in the reservoir, which required Denver Water to increase chlorine treatment to mitigate the problem, ultimately leading to higher treatment costs (Moody 2013). Denver Water has spent over \$26 million on water quality treatment, sediment removal, and infrastructure improvements as a result of the two fires (Denver Water 2013). To prevent further degradation of water quality and loss of reservoir storage capacity, Denver Water has partnered with USFS to invest \$16.5 million each over 10 years for forest fuel treatments in source water areas.

The city of Santa Fe, New Mexico, has similarly taken a closer look at its water supply's vulnerability to wildfire in the wake of a series of fires in 2000 and 2001 that were near the forests that supply their water. In 2002, the city established the Santa Fe Municipal Watershed Project with USFS, The Nature Conservancy, and local groups to implement an \$8 million fuel treatments project (City of Santa Fe 2013). More recently the city established the Watershed Investment Plan, which directs \$220,000 per year from water utility ratepayers to fund fuel treatment and related activities. The city estimates that the investment of \$5.1 million in forest fuels treatments in its water source watershed should result in avoided sediment dredging costs from the city's reservoirs of \$80 to 240 million (City of Santa Fe 2013).

The city of Bend, Oregon, like many other communities relying on surface water, must comply with the Long-Term 2 Enhanced Surface Water Treatment (LT2) rule under the Safe Drinking Water Act and treat water for cryptosporidium.¹ While ultraviolet treatment is the lowest cost treatment option, the Bend city council voted to invest instead in membrane filtration because they expect a wildfire to introduce sediment loads to the surface water supply in the near future and ultraviolet treatment alone would render the sediment-laden surface water unusable. The ultraviolet treatment over 20 years would cost roughly \$20 million, while membrane filtration over the same time period will cost over twice that (\$42 million or more), for a cost imposed by the risk of wildfire of over \$20 million (City of Bend 2013).

In 2004, a partnership with diverse stakeholders was reached in the Apache-Sitgreaves National Forests to begin a 10-year stewardship program in Arizona (The Nature Conservancy 2010). The stated project goals were to “reduce the impact of wildfires to communities at risk, to improve wildlife habitat, and to restore forest health, while helping rural communities stimulate employment in the wood products industry.” By 2010, 35,166 acres of land had been treated and an additional 14,553 acres were in the process of being treated that year. One year later, in 2011, the Wallow Fire burned over 500,000 acres and was the largest fire in the history of Arizona (Graham 2011). The fire threatened a number of communities, including Alpine and Greer. As part of the stewardship program, defensible zones were created around communities and many

¹ For details on the LT2 rule see U.S. EPA, 2013. Long Term 2 Enhanced Surface Water Treatment Rule. <http://water.epa.gov/lawsregs/rulesregs/sdwa/lt2/index.cfm>.

credit those treated areas for saving those communities (Keller 2011). As the fires reached the treated zones, they dropped from the crown to the ground and the flame length diminished enough to allow firefighters to attack the fire. All the structures in these towns but one survived the fire. Without the treatments, the property and structural damages, as well as economic costs, would have been significantly greater.

Mechanisms for financing watershed protection projects include the full range of public financing options, including taxes on fuel and general sales, fees on utility services, taxes on utility revenues, joint public-private enterprises, general tax revenues and bond measures, and voluntary contributions (Postel 2005). In theory, the most appropriate financing mechanism is designed so that those who benefit are also those who pay the costs, and in some cases the revenue from biomass or timber removed during fuel treatments activities can help alleviate the costs. As such, funding for fuel treatments and watershed protection efforts should be designed based on when, how, where, and to whom the costs and benefits occur.

1.3 Mokelumne Watershed Physical and Socioeconomic Characteristics

The upper Mokelumne River watershed spans 885 square kilometers across Alpine (pop. 1,102), Amador (pop. 37,953), and Calaveras (pop. 45,052) counties. The lower end of the upper watershed begins at Pardee Reservoir (approximately 600 feet of elevation) and continues upstream to the headwaters in the upper Sierra at over 10,000 feet of elevation (Figure 1.1). It is upstream of the Lower Consumes-Lower Mokelumne watershed, which includes parts of Amador, Calaveras, Sacramento and San Joaquin counties (US EPA 2012, US Census 2010). The upper Mokelumne watershed overlaps with two National Forests—Eldorado and Stanislaus, with BLM as another primary Federal landowner in the watershed.

There are notable recreational uses on the river, including famous rafting and kayaking runs. The average acre of Eldorado National Forest receives about 56 inches of precipitation annually and average annual runoff is about 29 inches. This is roughly equal to 2.4 acre-feet of water per acre of land, per year (USFS 2013).

1.4 Fire History

The California Department of Forestry and Fire Protection, Fire Resource Assessment Program (FRAP), publishes data for California describing the areas in the state that are at risk from wildfire (CAL FIRE 2012). Significant portions of Amador and Calaveras counties are considered to be high or very high fire-hazard areas (Figure 1.2).

There are several communities in Amador, Calaveras, and Alpine counties that are at risk from fires from forested lands. FRAP forecasts significant future urban development in high fire hazard areas in the Mokelumne watershed, including central Calaveras County.

Figure 1.1: Map of Mokelumne River watershed

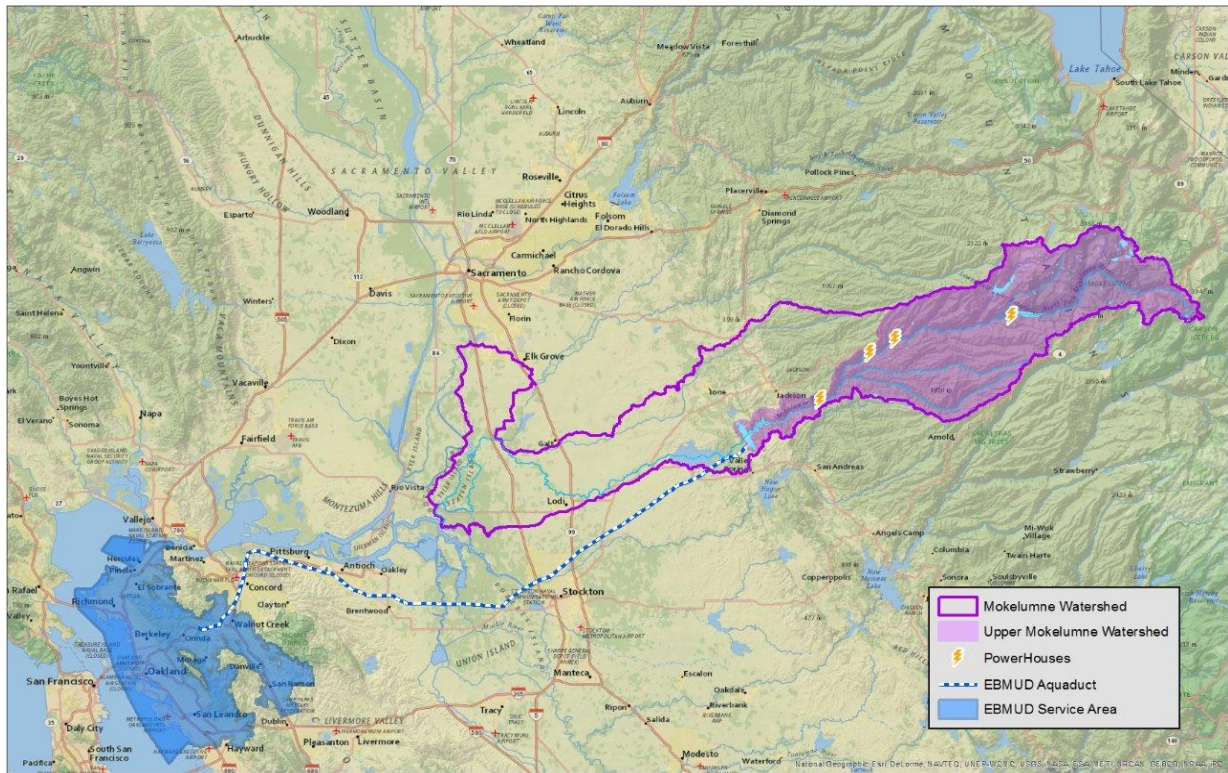
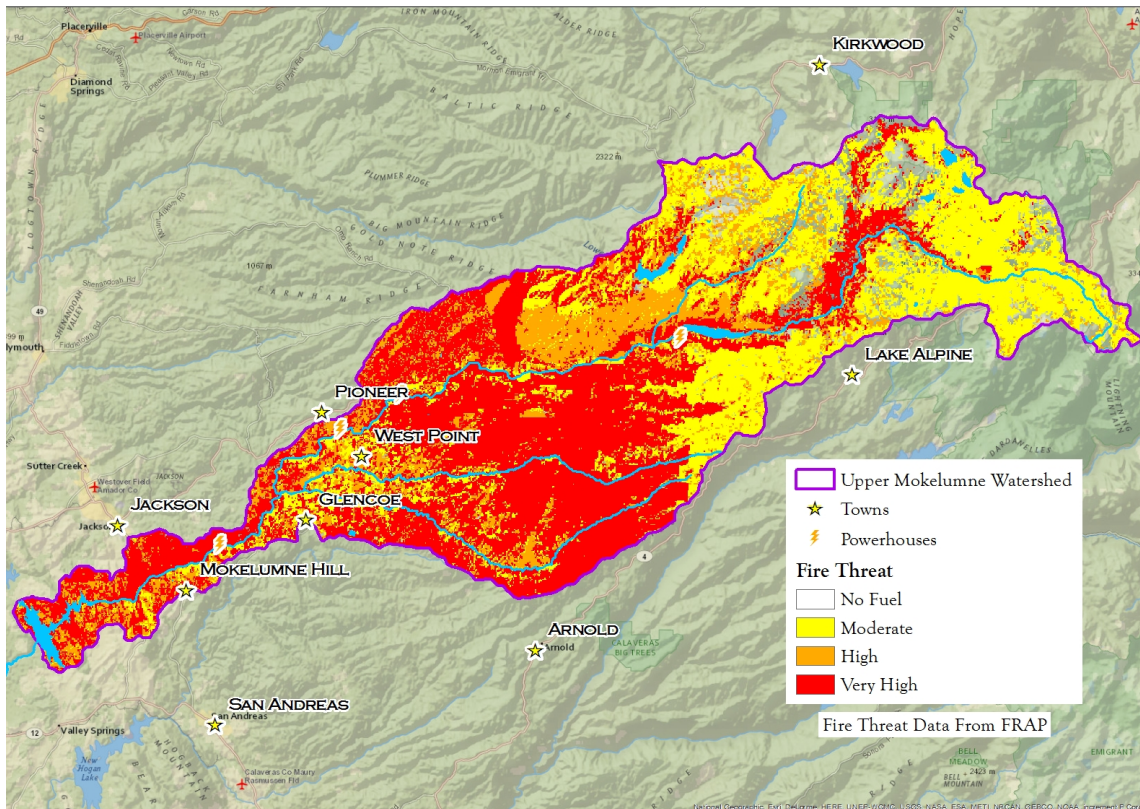


Figure 1.2: Map of fire hazard in the upper Mokelumne watershed



Wildfire in the Western United States is increasing in frequency, severity, and extent—both on the landscape and the calendar (Westerling 2006; Ecological Restoration Institute 2013). Lloyd’s of London, one of the top international insurance agencies, issued a review of wildfire risk for insurers and concluded that climate change has increased the risk, and will continue to increase risk, of wildfire in western North America (Doerr 2013). In Chapter 3 and Appendix A we discuss the risk of wildfire in the Mokelumne watershed, based on the historic fire record for the area. However, as the 2013 Rim Fire demonstrates, the historic fire record may not be an indicator of future fire activity in the Sierra Nevada. If future fires in the Mokelumne watershed are more extreme than those modeled in this exercise, the costs would be expected to be higher than those discussed in this analysis.

1.5 Infrastructure

The East Bay Municipal Utility District (EBMUD) supplies much of the San Francisco East Bay’s water demand, with 1.3 million customers. Over 90% of EBMUD’s water supply, roughly 155 million gallons per day, comes from Pardee Reservoir (Figure 1.1) (East Bay Municipal Utility District).

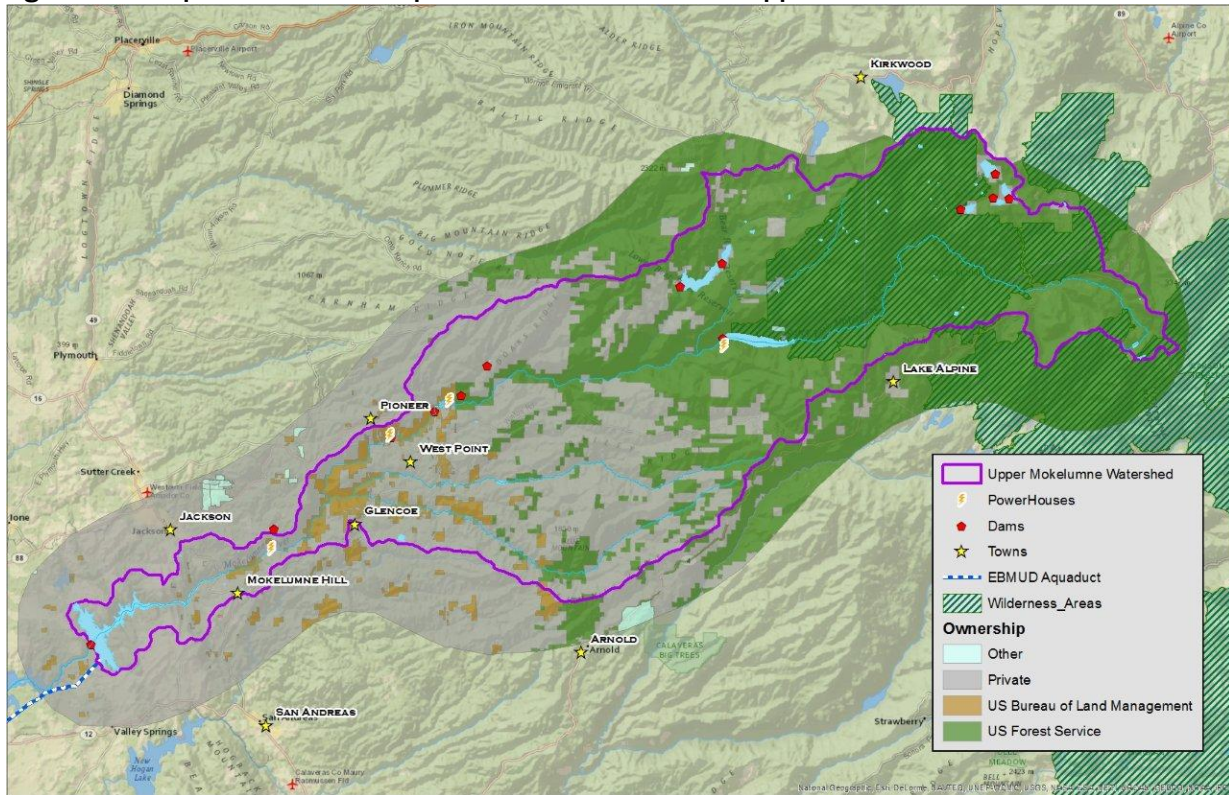
Pacific Gas and Electric (PG&E) operates a series of reservoirs, canals, and diversions in the upper Mokelumne watershed, with the majority of their reservoir storage located in Salt Springs Reservoir and all of their electricity generation situated downstream of Salt Springs Reservoir. See Chapter 6 for more information on utility infrastructure operations in the upper Mokelumne watershed.

USFS, BLM, the counties, the state, the utilities, and private landowners, including Sierra Pacific Industries, own and manage roads, transmission lines, and other infrastructure in the upper Mokelumne watershed (Figure 1.3). The area also holds rural homes and other structures at risk from wildfire, as well as timber resources, which are further described in Chapter 5.

1.6 Summary

This report documents an analysis of how upper watershed restoration treatments, in the form of fuel hazard reduction and forest health management, could benefit downstream beneficiaries. This includes the protection of property, structures, roads, and timber, as well as a reduction in the operational costs of energy and water delivery and the reduction in fire suppression and postfire restoration costs by state and federal agencies. The report also describes how these treatments can benefit socioeconomic and environmental conditions for watershed inhabitants and local resources.

Figure 1.3: Map of land ownership and infrastructure in the upper Mokelumne watershed



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Disclaimer

This report is rich in data and analyses and may help support planning processes in the watershed. The data and analyses were primarily funded with public resources and are therefore available for others to use with appropriate referencing of the sources. This analysis is not intended to be a planning document.

The report includes a section on cultural heritage to acknowledge the inherent value of these resources, while also recognizing the difficulty of placing a monetary value on them. This work honors the value of Native American cultural or sacred sites, or disassociated collected or archived artifacts. This work does not intend to cause direct or indirect disturbance to any cultural resources.

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Contact Information

For More Information:



David Edelson
dedelson@tnc.org
Kristen Podolak
kpodolak@tnc.org



Kim Carr
kim.carr@sierranevada.ca.gov
Nic Enstice
nic.enstice@sierranevada.ca.gov



Sherry Hazelhurst
shazelhurst@fs.fed.us